(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 743 092 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
10.07.2013 Bulletin 2013/28

(21) Application number: **05773646.4**

(22) Date of filing: **29.03.2005**

(51) Int Cl.:
F02C 9/28 *(2006.01)* ***F02C 9/30*** *(2006.01)*
F02C 9/46 *(2006.01)* ***F02C 7/236*** *(2006.01)*
F02C 9/26 *(2006.01)*

(86) International application number:
PCT/US2005/010364

(87) International publication number:
WO 2005/104678 (10.11.2005 Gazette 2005/45)

(54) TWO-DISPLACEMENT SETTING VARIABLE DISPLACEMENT PUMP USED AS ENGINE OVER-THRUST PROTECTION WITH FUEL SYSTEM THERMAL BENEFIT

VERSTELLPUMPE MIT ZWEIFACHEM VERSTELLMODUS ZUR VERWENDUNG ALS TRIEBWERKSCHUTZ VOR HÖCHSTSCHUBKRAFT MIT THERMISCHEM NUTZEN FÜR DAS BRENNSTOFFSYSTEM

POMPE A CYLINDREE VARIABLE A DOUBLE REGLAGE DE CYLINDREE UTILISEE COMME PROTECTION CONTRE UNE SURPOUSSEE DU MOTEUR A SURCROIT D’EFFICACITE THERMIQUE POUR LE SYSTEME DE CARBURANT

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR

(30) Priority: **29.03.2004 US 557429 P**

(43) Date of publication of application:
17.01.2007 Bulletin 2007/03

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Printed by Jouve, 75001 PARIS (FR)

Description

Background of the Invention

[0001] The present invention relates to a fuel delivery system. It finds particular application in conjunction with modem jet aircraft turbine engines, finding particular application during a control system failure, and will be described with particular reference thereto. However, it is to be appreciated that the present exemplary embodiment is also amenable to other applications.

[0002] Known fuel delivery systems have proven effective to date to provide desired fuel flow in a wide array of circumstances. Modern jet aircraft engines are now required to prevent even rare occurrences of uncontrolled engine over-thrust during control system failures. Cases of gross over-thrusting engines have resulted in several instances of loss of aircraft control due to substantial asymmetric thrust. As such, the Federal Aviation Administration (FAA) is considering new airworthiness regulations that dictate control system design that will prevent engine over-thrust conditions.

[0003] Engine over-thrust conditions are generally caused by a major loss of control functions that result in full fuel pump flow being delivered to an engine combustor. Many schemes are being considered that will bypass the pump delivered flow away from the engine combustor as to control flow delivered to the combustor, and thus engine thrust. These systems require additional hardware features that are independent of the normal control means.

[0004] In addition, as jet aircraft engines become more fuel efficient, modern engines have an ever increasingly difficult task of managing fuel system heat. Reduced windmill speeds add to the heat management task by forcing the engine fuel pump to be of a larger capacity, and therefore generate a larger quantity of heat to be dissipated.

[0005] US 6526743, on which the preamble of claim 1 is based, discloses a fuel control system for a gas turbine engine. The system has a vane pump with a variable delivery capacity and a metering valve downstream of the pump.

[0006] CH 266733 discloses a gas turbine plant wherein fuel from a pair of fuel pumps is delivered to the burners of the gas turbine plant via a throttle. If a turbine rotor of the gas turbine plant exceeds a maximum threshold speed, fuel flow from the pumps is reduced.

[0007] There is a need for an improved fuel delivery system which provides over-thrust protection with improved fuel system thermal benefit.

Brief Description of the Invention

[0008] A new and improved fuel delivery system for a jet aircraft turbine engine is provided.

[0009] According to one aspect of the invention, there is provided a fuel delivery system for an associated jet aircraft turbine engine, comprising: a pump for pressurizing fuel, the pump having a first pump displacement setting for a first desired high mass flow of fuel and a second pump displacement setting distinct from the first pump displacement setting for a second desired low mass flow of fuel; and a metering valve downstream of the pump for selectively regulating fuel delivery, characterized in that the fuel delivery system is for the associated jet aircraft turbine engine during a control system failure; the pump has only the first and second pump displacement settings, the pump configured to operate in only one of the first and second pump displacement settings; and means for preventing engine over-thrust operatively associated with the pump for positioning the pump in the second pump displacement setting in response to a control system failure whereby pump flow to the associated engine is limited to provide over-thrust protection. The fuel delivery system preferably employs a variable displacement pump for pressurizing the fuel.

[0010] The variable displacement pump is in the first setting to deliver the first desired, high mass flow, as would be required for a large amount of flow such as starting and takeoff. The pump is operative in the second, low mass flow, fuel displacement setting where reduced flow requirements are needed such as high altitude cruising or descent. A controller may selectively position the pump in only one of the first and second fuel displacement settings. The means for preventing engine over-thrust may in the event of major control system failure, position the pump in the second low flow displacement setting so that the pump will not produce an amount of flow that will enable the engine to accelerate to full power.

[0011] According to another aspect of the invention, there is provided a method of delivering fuel for an associated jet aircraft turbine engine, comprising the steps of: pressurizing fuel through a pump having only first and second fixed displacement settings for a first predetermined, high mass flow of fuel and a second predetermined, low mass flow of fuel; metering the fuel through a metering valve for supply to associated fuel nozzles; setting the pump to only one of the first and second displacement settings; and preventing engine over-thrust operatively associated with the pump by positioning the pump in the second pump displacement setting in response to a control system failure whereby pump flow to the associated engine is limited to provide over-thrust protection.

[0012] A benefit of the present invention is the ability to prevent engine over-thrust through the use of a variable displacement pump.

[0013] Another benefit of the present invention is the ability to minimize pump heating during a low flow displacement setting since the pump will contribute less heat to the fuel system, and permit fuel system heating to avoid fuel system icing at cold operating conditions by commanding the pump to its high flow displacement setting under substantially all conditions, regardless of system flow needs.

[0014] Still other benefits and aspects of the invention will become apparent from a reading and understanding of the detailed description of the preferred embodiments hereinbelow.

Brief Description of the Drawings

[0015] The present invention may take physical form in certain parts and arrangements of parts, preferred embodiments of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part of the invention.
[0016] FIGURE 1 is a simplified schematic of the fuel delivery system according to one embodiment of the present invention.
[0017] FIGURE 2 is a cross-sectional view of a preferred variable flow pump in a first displacement setting used in the fuel delivery system of FIGURE 1.
[0018] FIGURE 3 is a cross-sectional view of the variable flow pump in a second displacement setting.
[0019] FIGURE 4 is a graphical representation of speed versus fuel flow of the variable displacement pump operative in either the first or second displacement settings.

Detailed Description of the Invention

[0020] It should, of course, be understood that the description and drawings herein are merely illustrative and that various modifications and changes can be made in the structures disclosed without departing from the claimed invention. Like numerals refer to like parts throughout the several views.
[0021] As schematically illustrated in FIGURE 1, a fuel delivery system **10** of the present invention includes a high pressure variable displacement pump **20**, a fuel control **22**, a controller **24** and an engine such as a jet aircraft turbine engine **28**. Generally, fuel is inlet to a centrifugal boost stage (not shown), initially pressurized and passed through a fuel/oil heat exchanger (not shown) and a filter (not shown) before being input to the pump **20**. As shown in FIGURES 2 and 3, and also described in greater detail in co-pending US patent application Serial No. 10/474,225 (publication 20040136853), filed October 3, 2003 based on PCT/US02/09298, filed March 27, 2002, the preferred, variable displacement pump **20** includes a rotor **40**, which has multiple vanes **42** extending therefrom. A cam ring **44** surrounding the rotor and vanes is free to rotate relative to the vanes **42**. Thus, substantial losses between the outer tips of the vanes and a stationary cam ring as used in a typical vane pump are not encountered with the present invention. The cam ring **44** is supported in a continuous fluid bearing **46** defined by the pumped fuel. A spacer ring **50** is received around the rotor **40**. The spacer ring has a flat or planar cam rolling surface **52** and receives a pin 54. The pin cooperates with a cam sleeve **56** that is received around the rotor **40** to reposition the rotor and vanes to desired pumping positions.
[0022] First and second lobes or actuating surfaces **58, 60** are provided on the sleeve **56**, typically at a location opposite the pin. The lobes cooperate with first and second actuator assemblies **64, 66** to define means for altering a position of the cam sleeve **56**. The altering means selectively alter the stroke or displacement of the pump in a manner well known in the art. This variable displacement pump is preferred, although it will be understood that still other pumps may be used without departing from the scope and intent of the present invention.
[0023] In accordance with the present invention, the variable displacement pump **20** has a distinct, predetermined first pump displacement setting for a first desired mass flow of fuel (FIGURE 2) and a distinct, predetermined second pump displacement setting for a second desired mass flow of fuel (FIGURE 3). In use, the pump **20** operates in only one of the first and second pump displacement settings, the first pump displacement setting being a high mass flow displacement setting and the second pump displacement setting being a low mass flow displacement setting.
[0024] With reference to FIGURE 2, the actuating assemblies **64, 66** are actuated so that the cam sleeve **56** is positioned to vary the stroke of the pump **20**. That is, the cam sleeve **56** is positioned so that a close clearance is defined between the cam sleeve and the spacer ring **50** along the left-hand quadrants of the pump as illustrated in FIGURE 2. In this position, the pump **20** is fixed in its first displacement setting, the high mass flow displacement setting. This flow setting is selected while operational (i.e., does not have to be set while inoperative) so that sufficient fuel flow is provided to the system where large flows are required during operation such as starting and takeoff.
[0025] With reference to FIGURE 3, the positions of the actuating assemblies **64, 66** are altered when compared to FIGURE 2. The cam sleeve **56** is moved to vary the stroke of the vane pump to a second displacement setting, or the low mass flow displacement setting. This position is used during low flow conditions such as high altitude cruising or descent where flow requirements are reduced.
[0026] Thus, as shown in FIGURES 2 and 3, the pump **20** includes a distinct first stop and a distinct second stop, the first and second stops defining first and second positions of pump stroke travel. The first and second positions of pump stroke travel, in turn, define the respective first and second displacement settings (i.e. the operational parameters for pump stroke travel). These are the only two steady, commanded operational positions of the pump in accordance with the present invention. The pump either operates in a first or low flow condition or in a second or high flow position. It is recognized that the pump will transition through intermediate positions between the first and second displacement settings, however, the actuators and the pump control are operative so that the pump is commanded or directed to operate

in these one of the two distinct positions only. That is, if the pump is at the first displacement position and commanded to the second displacement position, the pump proceeds to the second position without stopping and operating steadily at any intermediate position.

[0027] The pump **20** delivers a controllable amount of fuel flow in response to control signals. As shown in FIGURE 1, the output flow from the pump travels in a flow path through the fuel control **22** that includes a metering valve (not shown) where the fuel is directed to the turbine engine **28** and combusted to produce power. The fuel control **22** is downstream of the pump **20** for selectively regulating fuel delivery to the engine. A bypass **80** is provided at the fuel control **22** for returning bypass flow to the pump inlet. Bypass flow is the remaining portion of the variable displacement pump **20** output flow that is not used for combustion purposes. The bypass flow is generally returned through a bypass valve (not shown) to the inlet of the pump **20** after passing through another fuel/oil heat exchanger (not shown). In this system, metered flow is established by adjusting the position of the metering valve of the fuel control **22** to obtain the desired mass flow. The metering valve position of the fuel control **22** is set by the controller **24**.

[0028] As noted above, prior art fuel control systems have been inadequate in controlling engine speed in the event of a control system failure. For example, incorporating a hydro-mechanical overspeed governor function to limit engine speed has been used as one solution in the event of a control system failure that would otherwise cause the engine to be uncontrollable. However, typical incorporation of the overspeed governor uses features of the fuel control which are responsible for normal flow regulation and may in fact be the cause for such an uncontrollable event. The present system of FIGURE 1 uses the variable displacement pump **20** to reduce the maximum flow and thereby limit delivered metered fuel flow to the engine **28** and thus prevent the occurrence of a gross over-thrust situation.

[0029] With continued reference to FIGURE 1, the controller **24** positions the pump 20 in one of the first pump displacement setting (FIGURE2) and the second pump displacement setting (FIGURE 3). The controller **24** can be a solenoid valve, for example, which is responsive to an electronic control signal for actuating the pump **20** to only one of the first and second pump displacement settings. Thus, the solenoid valve is commanded by the controller **24** and positions the pump **20** to one of its first and second modes of operation. In the event of a control system failure that would otherwise cause the engine **28** to over-thrust, the controller **24** positions the pump **20** to operate in the second fuel displacement setting whereby pump flow to the engine is limited.

[0030] In operation, fuel is pressurized through the pump **20** that has first and second fixed displacement settings for first and second predetermined mass flows of fuel. The fuel is metered through a fuel control **22** having a metering valve for supply to fuel nozzles of the engine **28**. The pump **20** is set to only one of the first and second displacement settings (FIGURES 2 and 3).

[0031] With the above operation, fuel system temperature is advantageously controlled by operating the variable displacement pump **20** in either its fixed high mass flow displacement setting (and avoiding fuel system icing in cold operating conditions) or fixed low mass flow displacement setting (and thereby reducing excess heat). Fuel exiting the fuel control **22** is bypassed to recirculate a portion of fuel to the pump **20**.

[0032] In summary, the present system uses the variable displacement pump **20** with physical stops of pump stroke travel, thereby setting two distinct pump displacement settings. Under normal conditions requiring a large amount of pumped flow (such as starting and takeoff), the pump **20** is stroked to the high flow displacement setting (FIGURE 2) to provide the complete range of required engine operation. As flow requirements reduce (at conditions such as high altitude cruise or descent), the pump **20** is placed to its low flow displacement setting (FIGURE 1). With the low flow displacement setting, the pump **20** contributes less heat to the fuel system. A control means such as a solenoid valve commanded by the controller **24** positions the pump **20** to each displacement setting.

[0033] In addition to minimizing pump heating, the proposed system configuration permits fuel system heating to avoid fuel system icing at cold operating conditions. Fuel system heating is accomplished by commanding the pump **20** to its high flow displacement setting under all conditions, regardless of system flow needs.

[0034] In addition to providing benefit to the thermal management aspect of the engine, the two-displacement pumping scheme of the pump **20** provides a means of preventing engine over-thrust. In the event of major control system failure that results in full pump flow being delivered to the engine **28**, the pump **20** would be set to the low flow displacement setting. At this low flow setting, the pump **20** will not produce an amount of flow that will enable the engine **28** to accelerate to full power. Engine speed (and thus thrust level) will equilibrate at a level depending on the displacement chosen for the low flow setting. In this way, engine over-thrust protection is provided without adding control hardware to the fuel delivery system.

[0035] It will be appreciated that other types of pumps may be used, namely any type of pump that could be set up into two displacement modes. It could even be a two stage gear pump, one of which bypasses flow directly and the other stage doing the pumping. However, the illustrated and described variable pump is preferred.

[0036] Moreover, although other solutions have been considered, these alternative solutions add additional components to the system, thereby adding to the cost, complexity, and/or the potential that other components could fail.

[0037] In one example as shown in FIGURE 4, the first position is 100% flow capacity while the second position is approximately 33% of the pump flow capacity. However, these values are illustrative only and are not to be construed as requirements to achieve the benefits and advantages described above.

[0038] The present invention has been described with reference to the preferred embodiment. Obviously, modifications and alterations will occurto others upon reading and understanding the preceding detailed description. It is intended that the exemplary embodiment be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims.

Claims

1. A fuel delivery system (10) for an associated jet aircraft turbine engine (28), comprising: a pump (20) for pressurizing fuel, the pump (20) having a first pump displacement setting for a first desired high mass flow of fuel and a second pump displacement setting distinct from the first pump displacement setting for a second desired low mass flow of fuel; and a metering valve (22) downstream of the pump (20) for selectively regulating fuel delivery, **characterized in that**

the fuel delivery system (10) is for the associated jet aircraft turbine engine (28) during a control system failure;

the pump (20) has only the first and second pump displacement settings, the pump (20) configured to operate in only one of the first and second pump displacement settings; and

means (22, 24, 80) for preventing engine over-thrust operatively associated with the pump (20) for positioning the pump (20) in the second pump displacement setting in response to a control system failure whereby pump flow to the associated engine (28) is limited to provide over-thrust protection.

2. The fuel delivery system (10) of claim 1, wherein the pump (20) includes distinct first and second stops defining operational parameters for pump stroke travel.

3. The fuel delivery system (10) of claim 1 or 2, wherein the pump (20) includes first and second stops in first and second extremes of pump stroke travel.

4. The fuel delivery system (10) of claim 3, wherein the first and second extremes of pump stroke travel define the respective first and second displacement setting.

5. The fuel delivery system (10) of any preceding claim, further comprising a controller (22) for positioning the pump (20) in one of the first and second pump displacement settings.

6. The fuel delivery system (10) of claim 5, wherein the controller (22) is a solenoid valve responsive to an electronic control signal for actuating the pump (20) to only one of the first and second pump displacement settings.

7. The fuel delivery system (10) of any preceding claim, further comprising a bypass passage (80) downstream of the pump (20) for returning excess flow to a pump inlet.

8. The fuel delivery system (10) of any preceding claim, further comprising a solenoid valve, the solenoid valve being commanded by the electronic control for positioning the pump to one of the first and second modes of operation.

9. The fuel delivery system (10) of any preceding claim, wherein the second pump displacement setting contributes less heat to the fuel system (10).

10. The fuel delivery system (10) of any preceding claim, wherein the first pump displacement setting permits fuel system heating for avoiding fuel system icing at cold operating conditions.

11. The fuel delivery system (10) of claim 1, wherein the pump (20) is a variable displacement pump.

12. A method of delivering fuel for an associated jet aircraft turbine engine (28), comprising the steps of:

pressurizing fuel through a pump (20) having only first and second fixed displacement settings for a first predetermined, high mass flow of fuel and a second predetermined, low mass flow of fuel;

metering the fuel through a metering valve (22) for supply to associated fuel nozzles;

setting the pump (20) to only one of the first and second displacement settings; and

preventing engine over-thrust operatively associated with the pump (20) by positioning the pump (20) in the second pump displacement setting in response to a control system failure whereby pump flow to the associated engine (28) is limited to provide over-thrust protection.

13. The method of claim 12, comprising the further step of controlling fuel system temperature by operating the pump (20) in its fixed high mass flow displacement setting.

14. The method of claim 12, comprising the further step of bypassing (80) fuel exiting the metering valve (22) to recirculate a portion of fuel to the pump (20).

Patentansprüche

1. Treibstofffördersystem (10) für ein zugeordnetes Flugzeug-Strahltriebwerk (28), umfassend: eine Pumpe (20) zum Unter-Druck-Setzen von Treibstoff, wobei die Pumpe (20) eine erste Pumpförderleistungseinstellung für einen ersten gewünschten hohen Massendurchsatz von Treibstoff und eine zweite Pumpförderleistungseinstellung, die sich von der ersten Pumpförderleistungseinstellung unterscheidet, für einen zweiten gewünschten niedrigen Massendurchsatz von Treibstoff hat; und ein Messventil (22) stromabwärts von der Pumpe (20) zum selektiven Regeln der Treibstoffförderung, **dadurch gekennzeichnet, dass**
das Treibstofffördersystem (10) für das zugeordnete Flugzeug-Strahltriebwerk (28) während eines Steuerungssystemausfalls ist;
die Pumpe (20) nur die erste und die zweite Pumpförderleistungseinstellung hat, wobei die Pumpe (20) dazu konfiguriert ist, nur in entweder der ersten oder der zweiten Pumpförderleistungseinstellung betrieben zu werden; und
Mittel (22, 24, 80) zum Verhindern eines Triebwerküberschubs, die mit der Pumpe (20) wirksam verbunden sind, um die Pumpe (20) in Reaktion auf einen Steuerungssystemausfall in die zweite Pumpförderleistungseinstellung zu versetzen, wodurch ein Pumpfluss zum zugeordneten Triebwerk (28) eingeschränkt wird, um einen Überschubschutz zu bieten.

2. Treibstofffördersystem (10) gemäß Anspruch 1, wobei die Pumpe (20) einen ersten und zweiten Anschlag, die verschieden sind, aufweist, die Betriebsparameter für die Pumpenhubverstellung definieren.

3. Treibstofffördersystem (10) gemäß Anspruch 1 oder 2, wobei die Pumpe (20) einen ersten und einen zweiten Anschlag in einem ersten und einem zweiten Extrempunkt der Pumpenhubverstellung aufweist.

4. Treibstofffördersystem (10) gemäß Anspruch 3, wobei der erste und der zweite Extrempunkt der Pumpenhubverstellung die erste bzw. die zweite Pumpförderleistungseinstellung definiert.

5. Treibstofffördersystem (10) gemäß einem der vorhergehenden Ansprüche, ferner umfassend eine Steuerung (22) zum Versetzen der Pumpe (20) entweder in die erste oder in die zweite Pumpförderleistungseinstellung.

6. Treibstofffördersystem (10) gemäß Anspruch 5, wobei die Steuerung (22) ein Magnetventil ist, das auf ein elektronisches Steuerungssignal anspricht, um die Pumpe (20) nur in entweder die erste oder die zweite Pumpförderleistungseinstellung zu versetzen.

7. Treibstofffördersystem (10) gemäß einem der vorhergehenden Ansprüche, ferner umfassend eine Umleitung (80) stromabwärts von der Pumpe (20) zum Rückführen eines überschüssigen Flusses an den Pumpeneinlass.

8. Treibstofffördersystem (10) gemäß einem der vorhergehenden Ansprüche, ferner umfassend ein Magnetventil, wobei das Magnetventil von der elektronischen Steuerung zum Versetzen der Pumpe in entweder die erste oder die zweite Betriebsart gesteuert wird.

9. Treibstofffördersystem (10) gemäß einem der vorhergehenden Ansprüche, wobei die zweite Pumpförderleistungseinstellung weniger Wärme an das Treibstoffsystem (10) liefert.

10. Treibstofffördersystem (10) gemäß einem der vorhergehenden Ansprüche, wobei die erste Pumpförderleistungseinstellung ein Beheizen des Treibstoffsystems gestattet, um unter kalten Betriebsbedingungen eine Systemvereisung zu vermeiden.

11. Treibstofffördersystem (10) gemäß Anspruch 1, wobei die Pumpe (20) eine Pumpe mit variabler Förderleistung ist.

12. Verfahren zum Fördern von Treibstoff für ein zugeordnetes Flugzeug-Strahltriebwerk (28), umfassend die folgenden Schritte:

    Unter-Druck-Setzen von Treibstoff über eine Pumpe (20), die nur eine erste und eine zweite feste Einstellung für einen ersten vorbestimmten hohen Massendurchsatz von Treibstoff und einen zweiten vorbestimmten niedrigen Massendurchsatz von Treibstoff hat;
    Messen des Treibstoffs durch ein Messventil (22) zur Lieferung an zugeordnete Treibstoffdüsen;
    Versetzen der Pumpe (20) lediglich in entweder die erste oder die zweite Förderleistungseinstellung; und
    Verhindern eines Triebwerk-Überschubs in wirksamer Zuordnung mit der Pumpe (20) durch Versetzen der Pumpe (20) in die zweite Pumpförderleistungseinstellung in Reaktion auf einen Steuerungssystemausfall, wodurch der Pumpfluss an das zugeordnete Triebwerk (28) eingeschränkt ist, um einen Überschubschutz zu bieten.

13. Verfahren gemäß Anspruch 12, umfassend den weiteren Schritt des Steuerns einer Treibstoffsystemtemperatur durch Betreiben der Pumpe (20) in ihrer

festen Einstellung für einen hohen Massendurchsatz.

14. Verfahren gemäß Anspruch 12, umfassend den weiteren Schritt des Umleitens (80) aus dem Messventil (22) austretenden Treibstoffs zum Rückführen eines Teils des Treibstoffs zur Pumpe (20).

Revendications

1. Système d'alimentation en carburant (10) pour un moteur à turbine d'aéronef à réaction associé (28), comprenant : une pompe (20) destinée à pressuriser le carburant, la pompe (20) ayant un premier réglage de déplacement de pompe pour un premier débit massique élevé souhaité de carburant et un second réglage de déplacement de pompe distinct du premier réglage de déplacement de pompe pour un second débit massique bas souhaité de carburant ; et un répartiteur (22) en aval de la pompe (20) destiné à réguler sélectivement l'alimentation en carburant, **caractérisé en ce que**
le système d'alimentation en carburant (10) est destiné au moteur à turbine d'aéronef à réaction associé (28) pendant une défaillance du système de commande ;
la pompe (20) n'a que les premier et second réglages de déplacement de pompe, la pompe (20) étant configurée pour fonctionner dans seulement l'un des premier et second réglages de déplacement de pompe ; et
des moyens (22, 24, 80) destinés à empêcher une surpoussée du moteur opérationnellement associée à la pompe (20) afin de positionner la pompe (20) dans le second réglage de déplacement de pompe en réponse à une défaillance du système de commande, moyennant quoi l'écoulement de la pompe vers le moteur associé (28) est limité afin de fournir une protection contre la surpoussée.

2. Système d'alimentation en carburant (10) selon la revendication 1, dans lequel la pompe (20) comprend des première et seconde butées distinctes définissant des paramètres opérationnels pour la course de la pompe.

3. Système d'alimentation en carburant (10) selon la revendication 1 ou 2, dans lequel la pompe (20) comprend des première et seconde butées dans des premier et second extrêmes de course de pompe.

4. Système d'alimentation en carburant (10) selon la revendication 3, dans lequel les premier et second extrêmes de course de pompe définissent les premier et second réglages de déplacement respectifs.

5. Système d'alimentation en carburant (10) selon l'une quelconque des revendications précédentes, comprenant en outre une unité de commande (22) destinée à positionner la pompe (20) dans l'un des premier et second réglages de déplacement de pompe.

6. Système d'alimentation en carburant (10) selon la revendication 5, dans lequel l'unité de commande (22) est une vanne électromagnétique répondant à un signal de commande électronique afin d'actionner la pompe (20) dans seulement l'un des premier et second réglages de déplacement de pompe.

7. Système d'alimentation en carburant (10) selon l'une quelconque des revendications précédentes, comprenant en outre un passage de dérivation (80) en aval de la pompe (20) afin de renvoyer le débit excessif vers une admission de pompe.

8. Système d'alimentation en carburant (10) selon l'une quelconque des revendications précédentes, comprenant en outre une vanne électromagnétique, la vanne électromagnétique étant commandée par la commande électronique de positionnement de la pompe en l'un des premier et second modes de fonctionnement.

9. Système d'alimentation en carburant (10) selon l'une quelconque des revendications précédentes, dans lequel le second réglage de déplacement de pompe donne moins de chaleur au système de carburant (10).

10. Système d'alimentation en carburant (10) selon l'une quelconque des revendications précédentes, dans lequel le premier réglage de déplacement de pompe permet un chauffage du système de carburant afin d'éviter le givrage du système de carburant dans des conditions de fonctionnement froides.

11. Système d'alimentation en carburant (10) selon la revendication 1, dans lequel la pompe (20) est une pompe à déplacement variable.

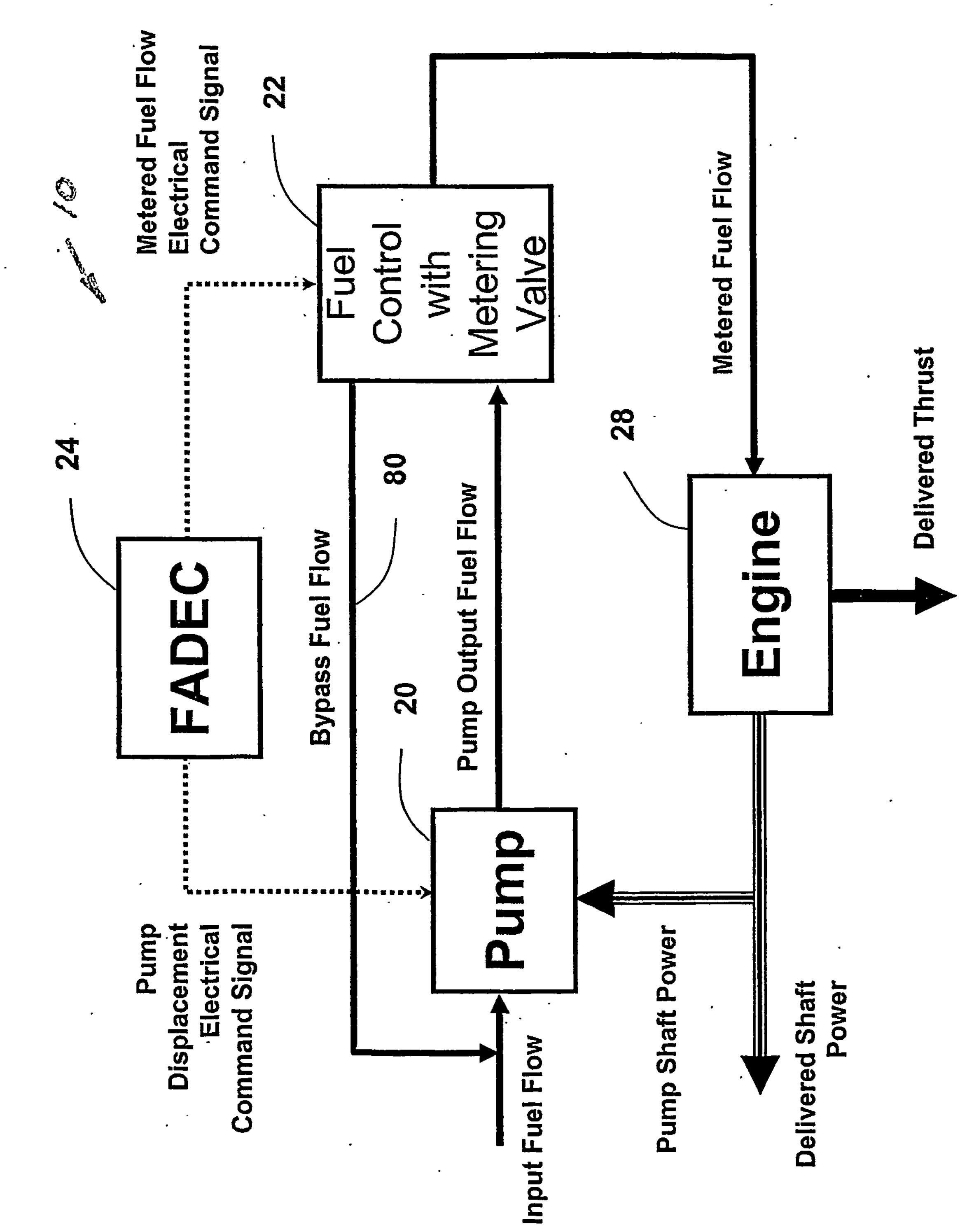
12. Procédé d'alimentation en carburant pour un moteur à turbine d'aéronef à réaction associé (28) comprenant les étapes de :

pressurisation du carburant par l'intermédiaire d'une pompe (20) n'ayant que des premier et second réglages de déplacement fixes pour un premier débit massique élevé prédéterminé de carburant et un second débit massique bas prédéterminé de carburant ;
répartition du carburant par l'intermédiaire d'un répartiteur (22) pour alimenter les injecteurs de carburant associés ;
réglage de la pompe (20) à uniquement l'un des premier et second réglages de déplacement ; et

prévention de la surpoussée de moteur opérationnellement associée à la pompe (20) en positionnant la pompe (20) dans le second réglage de déplacement de pompe en réponse à une défaillance du système de commande, moyennant quoi l'écoulement de la pompe vers le moteur associé (28) est limité pour fournir une protection contre la surpoussée.

13. Procédé selon la revendication 12, comprenant l'étape supplémentaire de commande de la température du système de carburant en exploitant la pompe (20) dans son réglage de déplacement de débit massique élevé fixe.

14. Procédé selon la revendication 12, comprenant l'étape supplémentaire de dérivation (80) du carburant sortant du répartiteur (22) afin de faire recirculer une partie du carburant vers la pompe (20).


Metered Fuel Flow
Electrical
Command Signal
22
Fuel
Control
with
Metering
Valve
24
FADEC
80
Bypass Fuel Flow
Pump Output Fuel Flow
20
Pump
Pump
Displacement
Electrical
Command Signal
Input Fuel Flow
Pump Shaft Power
Delivered Shaft
Power
28
Engine
Metered Fuel Flow
Delivered Thrust

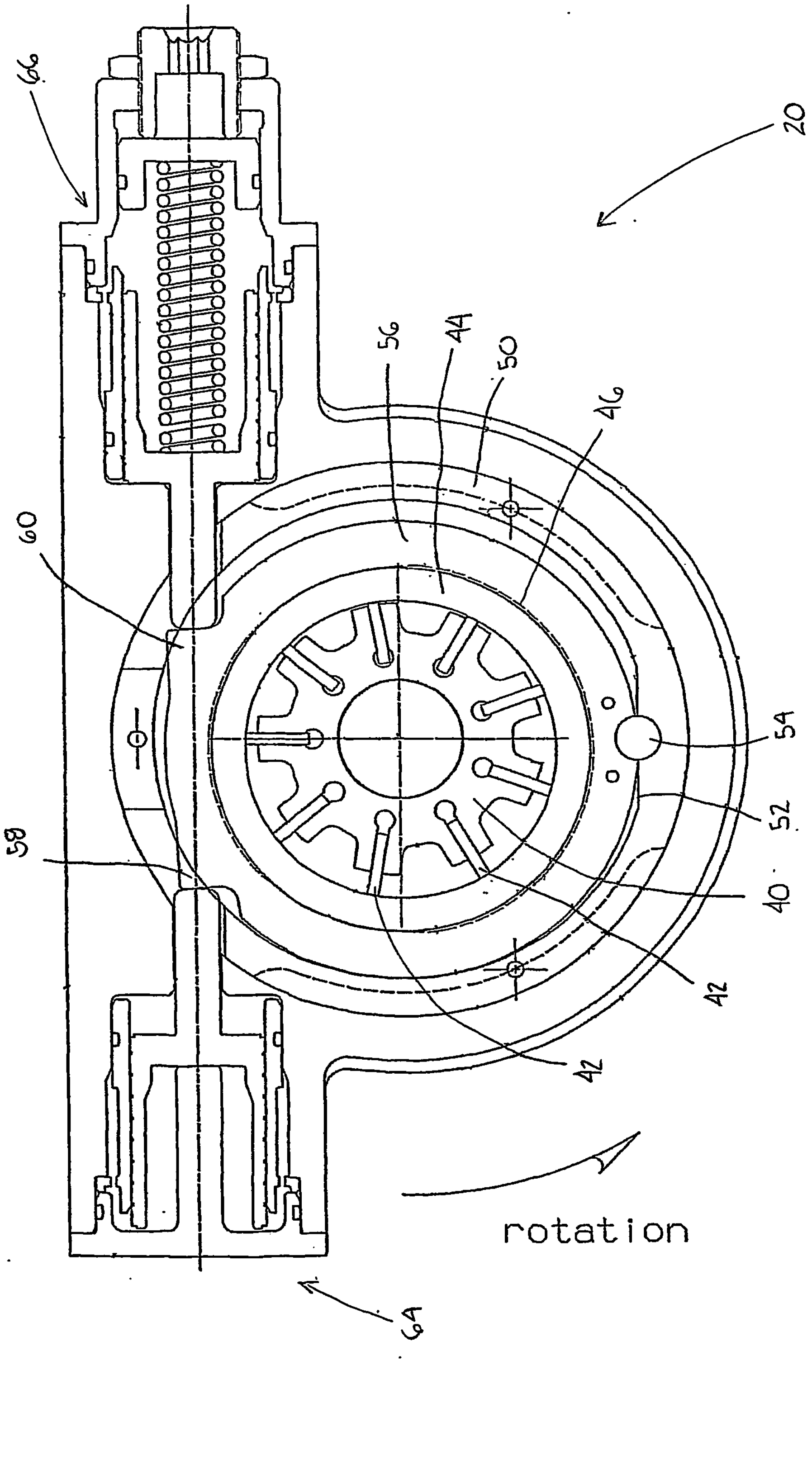


FIGURE 2

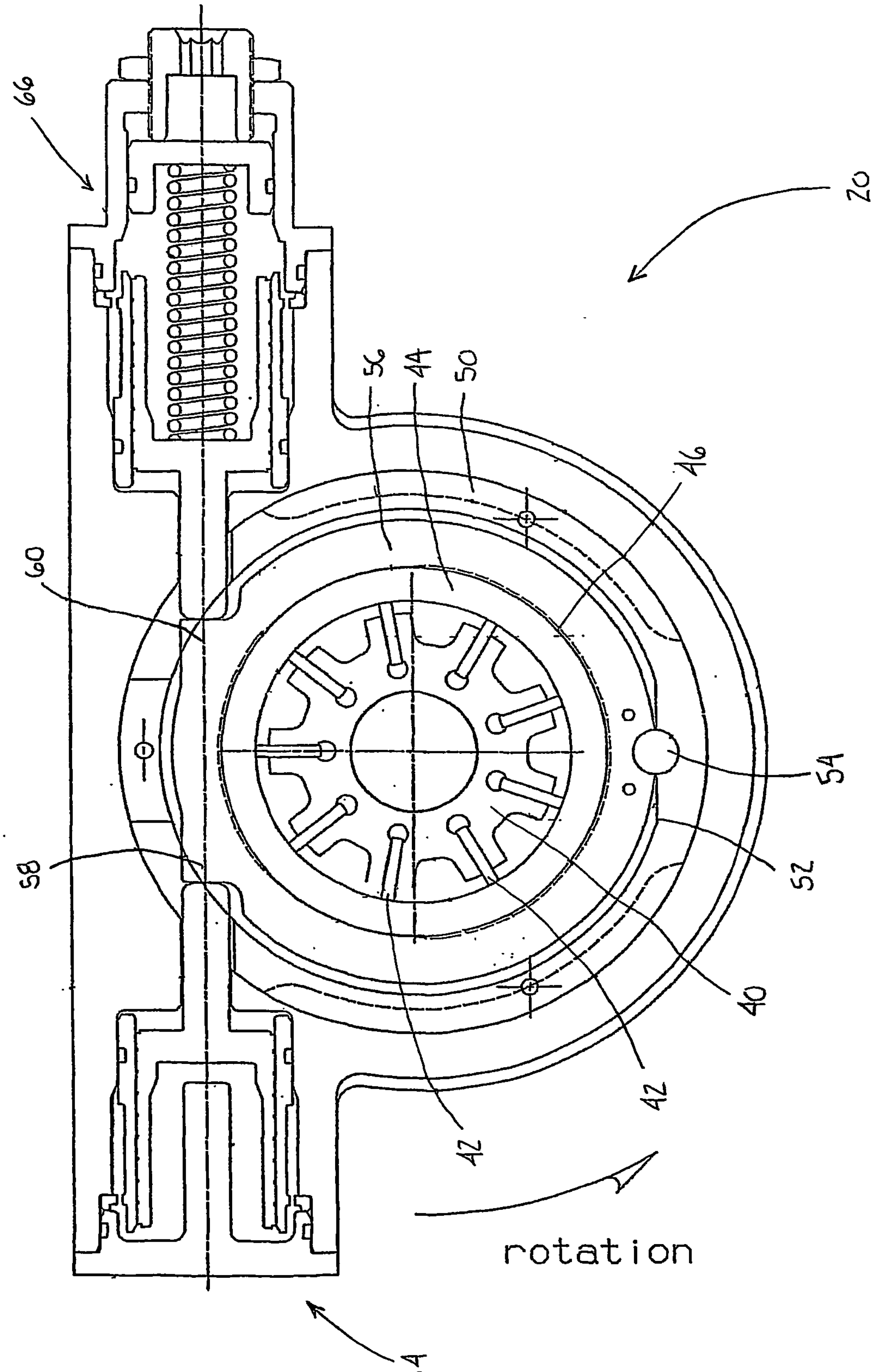


FIGURE 3

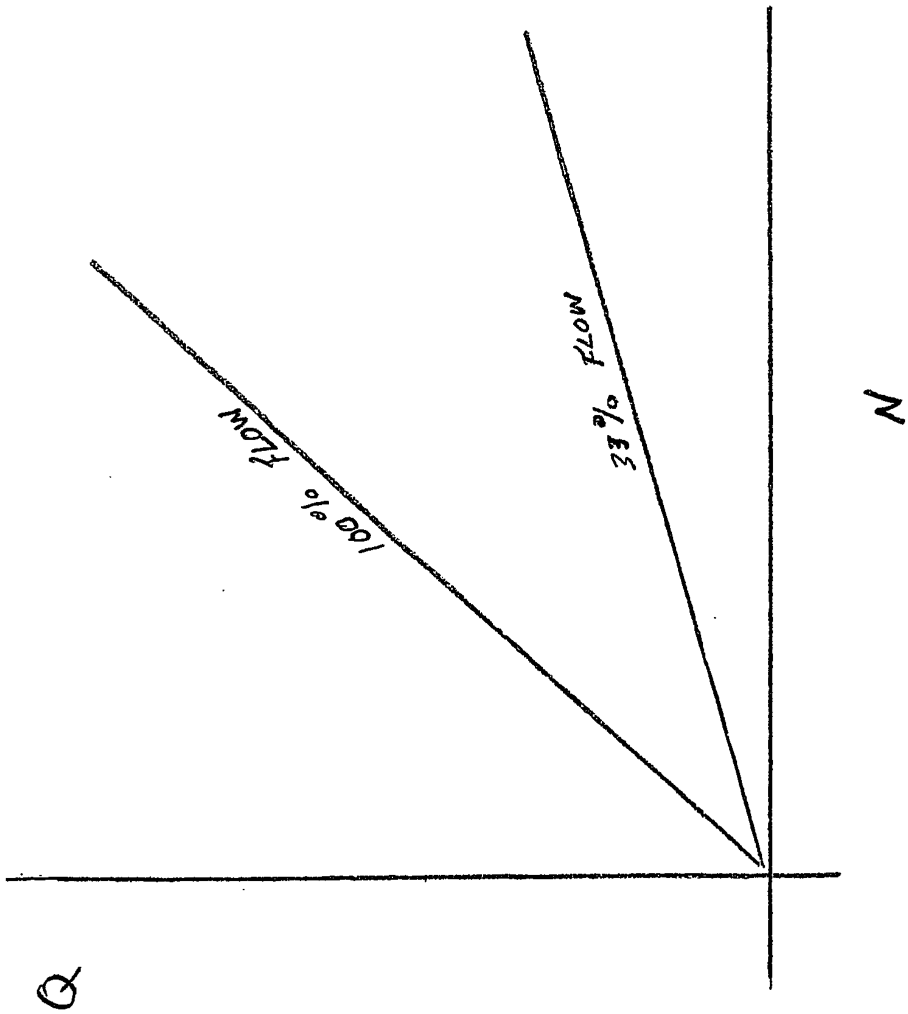


FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- CH 266733 **[0006]**
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